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Changes in the Population of Oysters in Loch Ryan between 1957 and 1967

By R. H. MILLAR, D.Sc., F.R.S.E.

Marine Station, Millport

January, 1968

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Changes in the Population of Oysters in Loch Ryan between 1957 and 1967

INTRODUCTION

Conditions on the oyster beds in Loch Ryan, in the south-west of Scotland, have been under investigation since 1957, and some of the earlier results have been published (Millar, 1961, 1963). The purpose of the present account is to describe later work, with special reference to the stocks of adult oysters and the changes in the population structure during ten years in which no commercial fishing has taken place.

The recorded commercial yields from the fishery were highest in the first quarter of the present century, and declined until, by 1954, the catch no longer justified the fishing effort (Millar, 1961, Fig. 2). Since that time no commercial fishing has taken place, and it has been possible to study some of the changes which have occurred in the population of oysters. The results are of interest in showing the re-establishment of a natural size-structure in a population which had been artificially reduced by the selective removal of individuals of medium and large size. It has also become possible to assess whether the beds are now ready to be reopened to commercial fishing.

METHODS

Surveys were carried out in 1957, 1962, 1964 and 1967, using commercial oyster dredges with a width of 3 feet (0·91 m) and a ring diameter of $2\frac{1}{2}$ inches (6·35 cm). The dredges were towed for known distances, the starting and finishing points of each haul being located by the Decca navigation system. In the first three surveys all oysters caught were cleaned, measured and weighed and returned to the beds. During the survey in 1967, in order to save time, the oysters were photographed, together with a scale, aboard ship, and the sizes were subsequently measured from photographic prints made in the laboratory. Weights were read from a graph of size/weight relationship prepared from samples of the oysters from the same beds (Fig. 1).

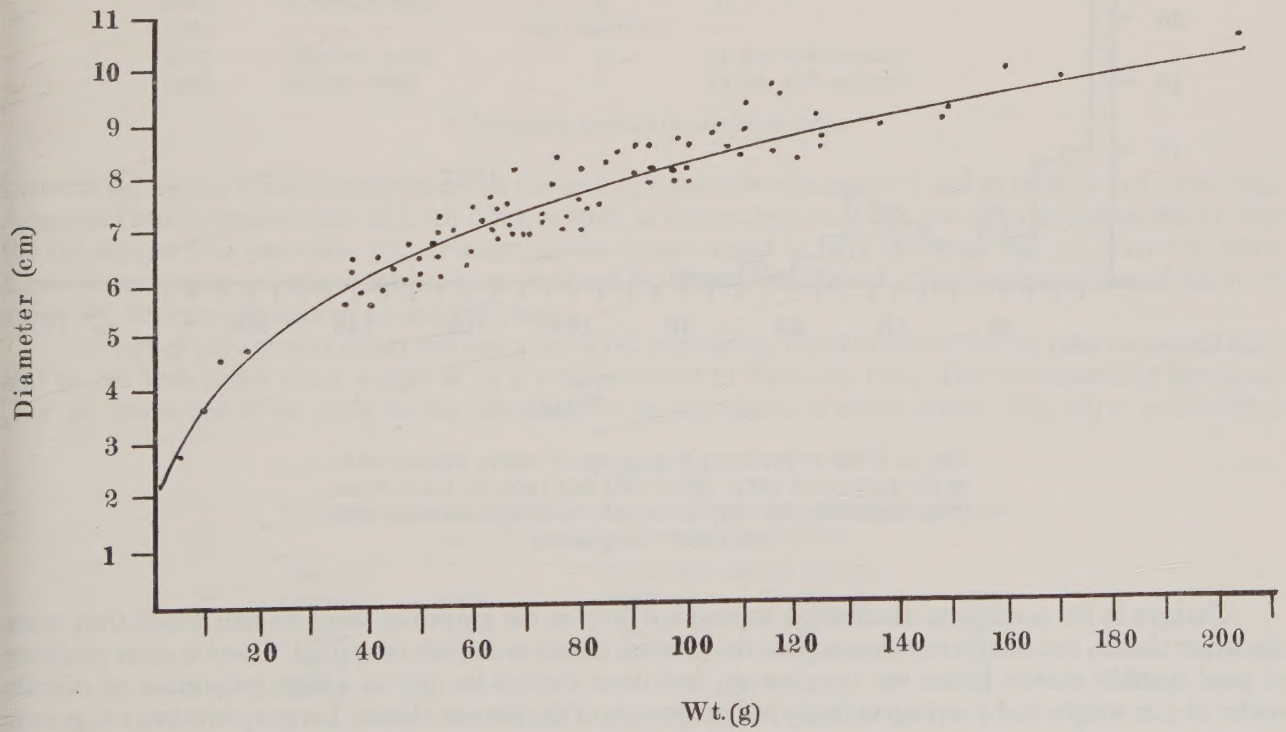

Fig. 1. The relationship of weight to diameter in native oysters from Loch Ryan.

STRUCTURE OF THE POPULATION

In 1957 relatively few medium and large oysters remained on the beds, as a result of fishing without adequate measures for the conservation of the stocks (Fig. 2). After five years without fishing, however, a marked change had occurred, and in 1962 the proportion of marketable oysters had risen significantly. This trend was confirmed by subsequent surveys. Thus, the proportion of oysters over 60 g in weight was only about 3% in 1957 but had risen to just under 50% in 1962 and 1964 and to about 64% in 1967.

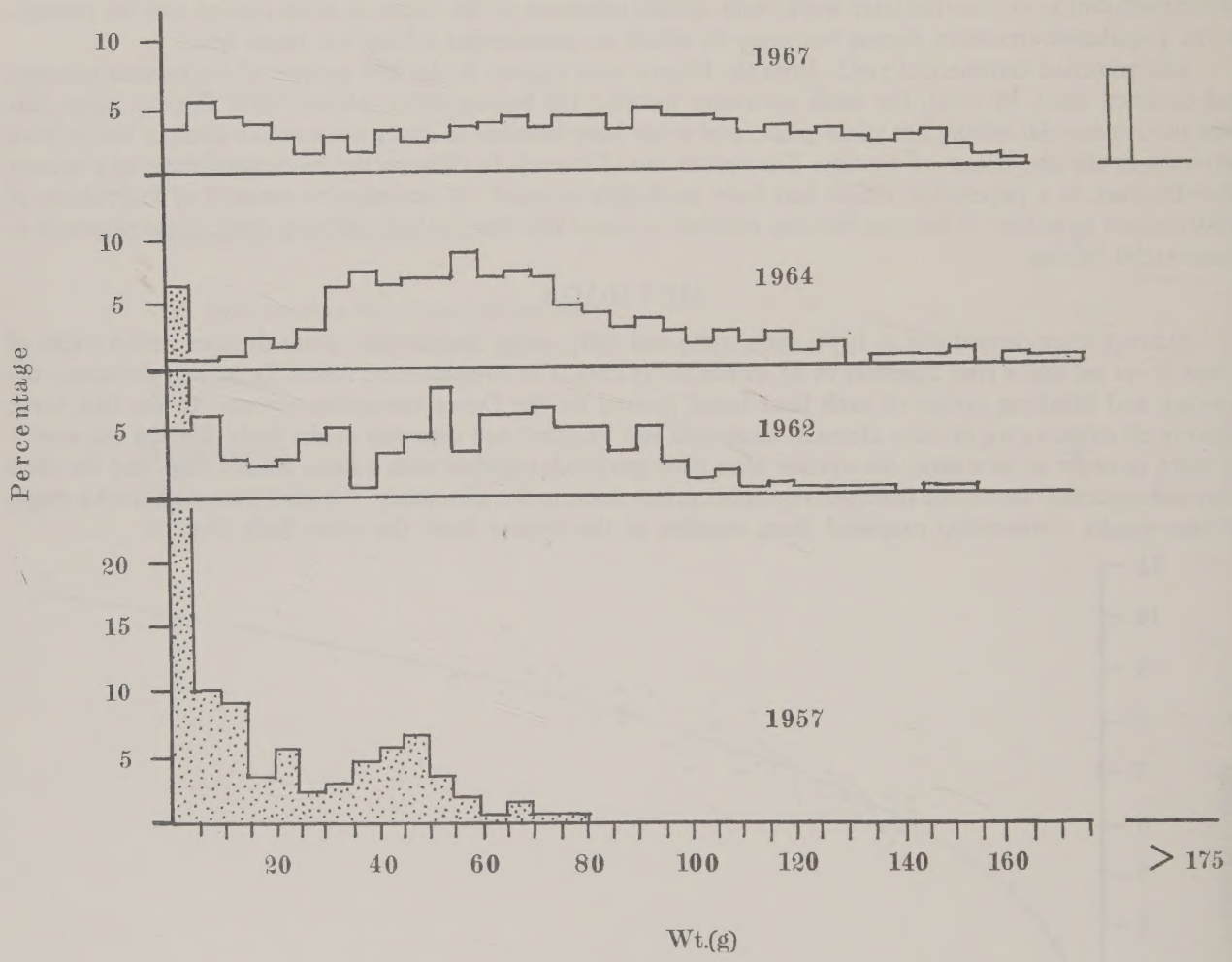

Fig. 2. Weight-frequency histograms of native oysters taken in the surveys of 1957, 1962, 1964 and 1967, in Loch Ryan. (The histogram for 1957 is stippled to avoid confusion with the other histograms.)

Changes in the percentage distribution depend not only on the growth of small animals which then enter the larger classes, but also on recruitment into the smallest classes as a result of spatfall. There is some evidence of good spatfalls shortly before the 1957 survey, and these showed in 1957 as a high proportion of animals under 20 g in weight and a correspondingly low proportion of the heavier classes. Large specimens, i.e. greater than 60 g, were almost completely absent at this time. Five years later nearly 50% of the oysters were over 60 g in weight, and this represents a real increase in the numbers of large animals on the beds, not merely an increased proportion.

The rate of recruitment by breeding was difficult to estimate. Indications of the regularity and intensity of spatfall have been obtained by counting spat on living oysters and dead oyster shell and on laid mussel shell. The results (Table I) show that some spatfall occurred in most years during the period of observation. In successful years this may amount to about one spat a few months old per 100 sq. cm of settlement surface, which is approximately equivalent to one on each living oyster. Only a small proportion of the spat survive, however. Walne (1961) found a survival of less than 8% after 6 months and less than 2% after 18 months from settlement in the Menai Straits, Anglesey. No strictly comparable figures are available for Loch Ryan, but examination of the oysters which had settled on laid mussel shell indicated mortalities of approximately 55%

TABLE I

NUMBERS OF SPAT ON LIVE OYSTERS, ON DEAD OYSTER SHELLS AND ON LAID MUSSEL SHELLS

Year of spatfall	Date examined	Approximate age of spat in months*	No. of spat
1958	October 1958	3	3 (on 26 oysters)
1959	June 1961	23	11 (on 80 oysters)
1960	March 1961	8	39 (on 125 mussel shells—Station S1)
			6 (on 134 mussel shells—Station S2)
			56 (on 133 mussel shells—Station S3)
			127 (on 130 oysters)
	June 1961	11	32 (on 43 oysters)
	August 1961	13	24 (on 140 mussel shells)
	October 1962	27	22 (on 166 mussel shells—Station S1)
			15 (on 140 mussel shells—Station S3)
	February 1964	43	65 (on 229 mussel shells—Station S3)
1961	December 1961	5	97 (on 92 oysters)
1962	September 1962	2	21 (on 75 mussel shells)
1963	February 1964	7	0
1964	——	not examined	——
1965	October 1965	3	31 (on 198 oysters)
1966	August 1966	1	23 (on 118 oysters)

* Assuming spatfall occurred in July.

between the ages of 8 and 27 months at one site and 33% between the ages of 8 and 43 months at another site. Amongst French oysters relaid in Loch Ryan in 1958, at about $2\frac{1}{2}$ years of age, the mean annual mortality over the subsequent four years was 5%; amongst similar oysters relaid in 1959 the figure was 4%, over five years. These figures agree quite well with results obtained by Walne, who found a fairly constant annual figure of about 6% between the ages of $1\frac{1}{2}$ and $11\frac{1}{2}$ years.

The rate of growth also affects the structure of the population. Oysters that settled in 1960 on mussel shell laid on the beds had a mean weight of 33 g when sampled in February 1964. The corresponding histogram (Fig. 3a) allows one of the peaks on the histogram for the population of native oysters (Fig. 3b) to be identified

TABLE II

PERCENTAGE ANNUAL INCREASE IN MEAN WEIGHT OF BRITTANY OYSTERS ALL $2\frac{1}{2}$ YEARS OLD AT TIME OF RELAYING

Year of relaying	Percentage annual increase			
	1958	1959	1960	1961
1958	60	30	38	22
1959	—	67	31	33
1960	—	—	48	53

as the 1960 settlement. Although figures are not available for the growth rate of native oysters beyond the age of three years, observations on relaid Brittany oysters (Millar, 1963) can be used to calculate approximate increases in mean weight (Table II).

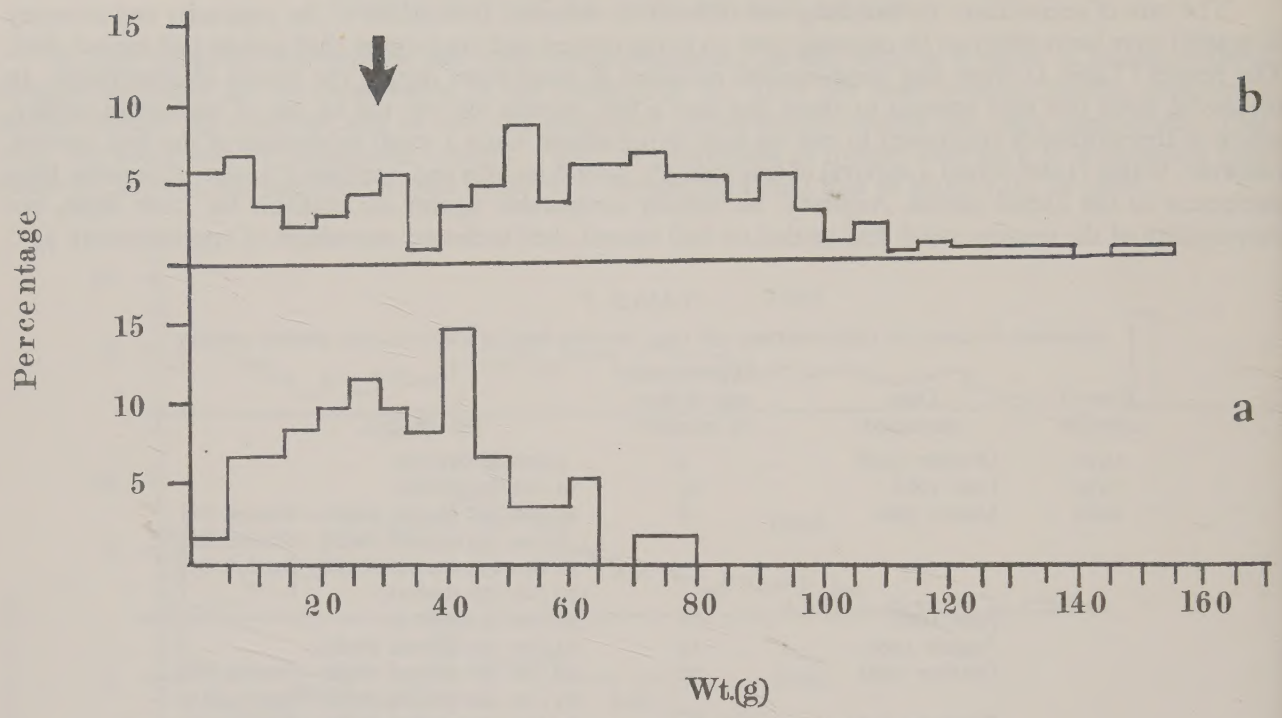

Fig. 3. (a) Weight-frequency of 1960 settlement on laid mussel shell sampled in February 1964: (b) weight-frequency of native oysters sampled in June 1964, with arrow indicating peak representing 1960 settlement.

THE DISTRIBUTION AND STOCK OF OYSTERS

The results of dredging surveys carried out from 1958 to 1960 have already been reported (Millar, 1963), and the present distribution of native oysters, as shown by surveys in 1967, is depicted in Figure 4. The pattern of distribution is similar to that shown by the earlier surveys, with the main concentrations on the eastern side south of Leffnoll Point and in the southern area off Stranraer. The concentration of stock on the western side which appeared in the earlier surveys and which was known to exist when the fishery was being operated was less evident.

A reliable estimate of the total stock of oysters is difficult to obtain, principally because (1) the efficiency of the dredge is not accurately known and probably varies with the nature of the ground, (2) only a small fraction of the total area of the beds could be sampled, and (3) the density of the stock varies considerably over the beds.

The efficiency of the dredge is assumed to be about one-third, a figure based on the work of Shelbourne (1957). The total area swept in all hauls during the surveys of 1967 was about 18,400 sq. yd (15,400 sq. m) and the total number of oysters of all sizes 1,281. At the assumed efficiency of dredging this represents a mean density of about 1,000 oysters per acre (4,046 sq. m), and of these about 640 per acre are over 60 g in weight. Based on these figures the estimated stock is at present about 0·4 million oysters of all sizes, of which about 250,000 are more than 60 g in weight. These figures may give a false impression of the state of the beds, because a large proportion of the area bears few oysters, the most productive areas being of limited extent. About 70% of the ground sampled showed a density of oysters of less than 20 per haul, and on only about 7% of the ground was the density over 100 per haul. From a practical point of view these figures do not mean that 70% of the beds are unsuitable for oysters, but that over a large area spatfall is severely restricted by the scarcity of surfaces on which the larvae can settle. This explanation is supported firstly by the occurrence of spatfall on shell laid in places with few adult oysters, and secondly by the survival and growth of oysters laid in such places.

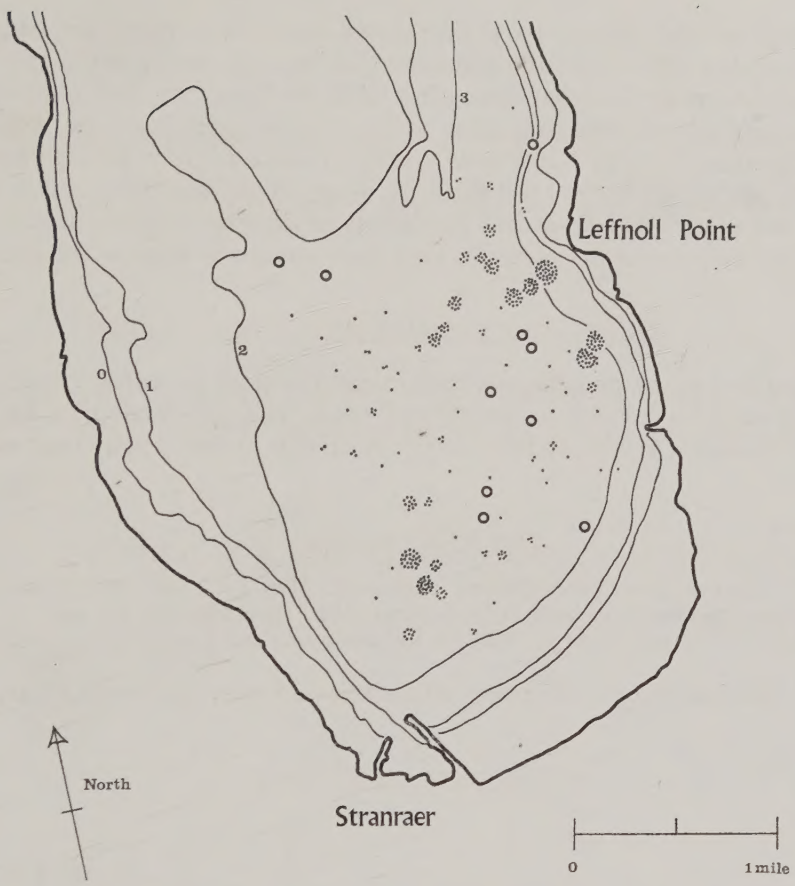

Fig. 4. The distribution of native oysters in Loch Ryan as shown by the survey of 1967. One point represents 1–4 oysters, two points represent 5–9 oysters, three points 10–14 oysters and so on. Depth contours are shown in fathoms.

DISCUSSION

The decline in the stocks of oysters in Loch Ryan, culminating in the closure of the fishery about 1954, could have resulted from the onset of unfavourable ecological conditions or from overfishing. There is no evidence of significant changes in the ecological conditions, although it should be said that, in the absence of observations during the period when stocks were high and the fishery was productive, it has not been possible to make comparisons. The absence of fishing over the past thirteen years, has, however, coincided with marked changes in the population of native oysters, which now show a much higher proportion of large animals and probably a higher total stock. These changes reveal the effect of fishing on this limited and self-contained population, which can receive no natural recruitment from sources outside the area. This evidence gives rise to the belief that the native stock could again support a fishery, but two conditions seem to be essential. The first is that the total stock should be increased and the second that the annual catch should be limited to a level which allows the population to maintain a balanced structure. The stock would increase faster if spatfall were improved by the provision of additional settlement surfaces, in the form either of shell or of artificial collectors. It is impossible to calculate the size of the population that would be attained under undisturbed conditions, but the recorded annual catches were for a number of years greater than the present total estimated stock. It is therefore probable that numbers are still far below the natural upper limit. This ceiling could be raised significantly by increasing the amount of clean shell, but only a very large operation would add amounts of shell comparable to those already present. The stocks could also be increased by laying imported oysters, and

the experiments already reported (Millar, 1963) have shown that French oysters can be grown and fattened in Loch Ryan. It is likely that they would also contribute, as breeding stock, to the spatfall.

In spite of the improvement which has taken place since the fishery was discontinued, the density of stock is still very low compared with densities on other commercial grounds. A survey of the Rivers Crouch and Roach in Essex (Shelbourne, 1957) showed a mean density of about 2 oysters per sq. yd over the whole area of approximately $13\frac{1}{2}$ million sq. yd, but in Loch Ryan the mean density was about only 0·07 oysters per sq. yd. In favourable areas, and under good conditions the density of stock on commercial beds can be as high as 40 per sq. yd, a figure which indicates the potential yield from an area as large as the beds in Loch Ryan.

SUMMARY

Changes are described in the population-structure and the stock of native oysters on the beds in Loch Ryan during a period when no commercial fishing took place. The size-distribution has shown progressively higher proportions of the larger groups, and the total population is probably now larger than at the first survey.

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